PRIVATE
DEPOSITORY

ROYAL ASTRONOMICAL SOCIETY.

VOL. V. *February* 11, 1842. No. 20.

Report of the Council of the Society to the Twenty-second Annual General Meeting, held this day.

THE return of the Anniversary of this Society affords the Council another opportunity of congratulating the members on the steady and progressive improvement of the science, for the promotion and encouragement of which they were originally formed. The public press has furnished us with the usual productions of the national observatories, while the labours and pursuits of private individuals have gradually added to that stock of knowledge and information which it is our desire to accumulate and place on record. The numerous books that have been presented to the Society shew the activity that has prevailed, both in this country and on the continent; and the papers, that have been read at the meetings, exhibit the interest which our members take in the progress of astronomy.

The Council are happy in being able to announce, that the expences of the Society have been kept greatly within the annual income; and that, in fact, the sum of £400 Consolidated 3 per Cents Stock has, during the last year, been purchased out of a portion of the surplus. This sum, together with £500 already in that fund, is available for any expences of the Society, should it at any future time be required; and is totally distinct from the sum of £1979 5*s*. 1*d*. New 3½ per Cents, which are the regular investments of the compositions of members, from time to time, agreeably to the original regulation of the Society, and are never appropriated to current expences. The Report of the Auditors, which is here subjoined, will shew the state of the finances of the Society.

RECEIPTS.

	£.	s.	d.
Balance of last year's account	448	16	3
1 year's dividend on £900 Consols	27	0	0
½ year's ditto on £1957 19*s.* 8*d.* New 3½ per Cents	34	5	3
½ year's ditto on £1979 5*s.* 1*d.* ditto	34	12	8
On account of arrears of contributions	88	4	0
83 annual contributions (1841–1842)	174	6	0
4 ditto (1842–1843)	8	8	0
2 compositions	42	0	0
11 admission fees	23	2	0
9 first year's contributions	18	18	0
Sale of Memoirs, by J. Hartnup, from Jan. 30, 1841, to Jan. 29, 1842	31	16	0
	£931	8	2

EXPENDITURE.

				£.	s.	d.
Purchase of £42 8*s.* 8*d.* New 3½ per Cents				42	0	0
Ditto of £400, 3 per Cent Consols				351	10	0
W. Magnay, for paper				54	11	6
Moyes and Barclay, for printing Monthly Notices, &c. for Session 1840-1841				22	18	0
W. Cubitt, for work done on basement story				12	14	7
1 year's salary to the assistant-secretary				80	0	0
Harrison and Co. for stationery				7	8	3
J. Hartnup, for commission on collecting £344 14*s.*				17	4	9
Postage of letters				12	10	4
Charges on books, and carriage of parcels				3	3	6
Porter's and charwoman's work, &c.				7	6	6
Tea, sugar, cakes, &c. for the evening meetings				13	13	0
Coals, candles, &c.				11	8	0
Conveyance of Memoirs and Greenwich Observations				3	19	8
Sundry disbursements by the treasurer				6	11	10
Taxes: Poor's rate	4	17	9			
Taxes: Land tax	3	2	6			
Taxes: Window duty	2	12	4			
Taxes: Church and rector's rate	2	6	9			
				12	19	4
Balance in the hands of the treasurer (Jan. 29, 1842)				271	8	11
				£931	8	2

The assets and present property of the Society are as follow :—

				£.	s.	d.
Balance in the hands of the Treasurer				271	8	11
Arrears 29th January, 1842.						
3 contributions of four years' standing	£25	4	0			
4 ——— of three ditto	25	4	0			
6 ——— of two ditto	25	4	0			
31 ——— of one ditto	65	2	0			
1 admission fee	2	2	0			
1 first year's contribution	1	1	0			
				143	17	0
£1979 5*s.* 1*d.* 3½ per Cent Annuities; £900 3 per Cent Consols — valued at				£2850	0	0
In the hands of J. Weale, on account of Memoirs sold by him				38	3	3

Unsold Memoirs of the Society.
Various astronomical instruments, books, prints, &c.

The progress and present state of the Society, with respect to the number of its Fellows and Associates, may be seen from the following abstract, continued from the Report of last year, viz. : —

	Compounded.	Annual Contributors.	Non-resident.	Patroness, and Honorary.	Total Fellows.	Associates.	Grand Total.
February 1841	91	127	88	6	312	36	348
Since elected	2	10	...	...	12	...	12
Deceased	...	−2	−2	...	−4	−1	−5
Resigned	...	−6	...	...	−6	...	−6
Removals	...	2	−2	...	...	...	...
February 1842	93	131	84	6	314	35	349

With respect to the instruments of the Society, it may be proper to place on record the present state of them.

The *Harrison* clock,
The *Owen* double portable circle,
The *Owen* quadruple portable sextant,
The *Beaufoy* circle,
The *Herschelian* 7-feet reflector,

are in the apartments of the Society.

The brass quadrant, said to be Lacaille's,

is in the apartments of the Royal Society, for safe custody.

The Standard Scale

is deposited at Mr. Baily's, for safe custody.

The remainder are lent, during the pleasure of the Society, to the several parties undermentioned : viz.

The *Fuller* theodolite, to the Lords of the Admiralty.
The *Beaufoy* clock,
The two invariable pendulums, } to the Royal Society.
The *Beaufoy* transit, to Mr. T. Jones.
The *Lee* circle, to Mr. Hopkins.
The *Wollaston* telescope to Professor Schumacher.
The other *Beaufoy* clock, to Major-General Pasley, R.E.

Amongst the losses by death, the Council have here to notice one among the Foreign members, which was announced at the last anniversary, namely, that of Professor Littrow, of Vienna, who was one of the earliest members of this Society. He contributed several papers which were read at the meetings, and which have been printed in the first four volumes of the *Memoirs*, exhibiting a spirit of research and inquiry into a variety of subjects connected not only with astronomy, but also with other branches of physical science. He was also the author of a valuable Treatise on Astro-

nomy, in 3 volumes octavo, in the German language, and continued, till the time of his death, to conduct the affairs of the Imperial Observatory at Vienna.

The Council have also to regret the loss of Mr. Frend, lately one of the Members of the Council of the Society.

William Frend was the son of George Frend, an alderman of Canterbury, in which city he was born, November 22, 1757. He received his education in his native place, at the King's School; and, after staying some time at St. Omer, was placed in a mercantile house at Quebec; but the breaking out of the disturbances in America destroyed his commercial prospects, and he returned to England. His wishes being directed towards the Church, he was placed at Christ's College, Cambridge, in 1775, and took the degree of B. A., with the honour of second wrangler, in 1780. After taking his degree, he almost immediately removed to Jesus College, of which he was elected fellow and tutor. In 1783 he was ordained, and afterwards obtained the living of Madingley, near Cambridge. In 1787, a change in his religious opinions took place, which ended in his adoption of the views of the Unitarians. The resignation of his living and the loss of the tutorship followed of course; but the laws of the University still allowed him to retain his fellowship. After some years of travel, he returned to Cambridge, and occupied himself further in the study of Hebrew and divinity. In 1793, a pamphlet, entitled *Peace and Union recommended to the Associated Bodies of Republicans and Anti-republicans*, was published by him, which contained distinct expressions of dislike to the doctrines and discipline of the Established Church. Immediately upon the publication of this pamphlet, both his college and various members of the senate commenced proceedings against Mr. Frend. The master and fellows of the former (by seven to four) "removed" him from residence in college, until proof of "good behaviour," and this sentence was confirmed by the visitor. Thirty-four members of the senate cited the author of the pamphlet before the Vice-chancellor (Dr. J. Milner), and a trial took place in his court, which lasted eight days. The result was, that a form of recantation was proposed to Mr. Frend, which he refused to sign; and sentence of "banishment" from the University was passed. This banishment is not expulsion, as persons unacquainted with the University generally believe, but a deprivation of the right to reside within the limits of the University; and, accordingly, though the sentence was confirmed on appeal, Mr. Frend continued to hold his fellowship till his marriage, and remained to the day of his death a Master of Arts, and a member of Jesus College. He retired of course from Cambridge, and came to London, where he maintained himself till 1806, by adding the profits of teaching and writing to the income derived from his fellowship. When the Rock Life Assurance was founded (1806), Mr. Frend, who had previously been consulted in the formation, was appointed actuary of that company, a post in which he remained until a severe illness compelled him (in 1826) to retire

from active life. His health, however, recovered, and he continued his mental employments with an activity very unusual at his age, until the beginning of the year 1840, when he was attacked by paralysis, under which he lingered with almost total loss of speech and motion, though with the smallest possible decay of mind or memory, until February 21 of the last year, when he closed a life which is regarded, even by those who differed from him, as a splendid example of honesty in the pursuit of truth, and of undaunted determination in the assertion of all that conscience required.

The losses and inconveniences which attended his banishment from college were not among the greatest risks which he ran. At a subsequent period, when the political struggle was at its height, and government prosecutions were frequently directed against the mere expression of opinion, Mr. Frend was one of the foremost among the despised minority which advocated emancipation and enfranchisement for all who were under religious or political disqualifications. At the time of certain of the prosecutions alluded to, it was currently said, that had the government succeeded in obtaining convictions, there was an intention of instituting several more; and Mr. Frend, it was stated, was to have been one of the defendants. This supposition cannot now be verified, even if it were true; but the rumour itself constitutes its object one of the leading opponents of the system which has since been so materially modified. With his political writings,* of which there were several, we have here nothing to do, any more than with those of a religious character. A true account of his scientific views cannot be easily given in a short space; nor can reasons for enlargement be better given than in the description itself of these views.

It generally happens that in recording the career of our departed members, we have little to say on their opinions, but only to specify the manner in which they carried them into practice; and small space may serve for great results. In the present instance we have to point out the singularities of thought which made Mr. Frend the last, we should suppose, of the *learned* Anti-Newtonians, and a noted oppugner of all that distinguishes algebra from arithmetic. Opposition to the theory of gravitation must in future be left to those whose mechanics do not distinguish velocity from force; and the rejection of the distinctive principles of algebra to those who would teach like philosophers what they have learnt like schoolboys, without going through any intermediate stage. But the subject of the present Memoir stands in neither of these predicaments; and it would be highly interesting in itself, and no less than due to expiring tenets, to specify the probable influences under which such a mind as that of Mr. Frend directed him to stand quite alone among men of his philosophical acquirements; especially when it is considered that, up to the age of thirty-six,

* The titles of these will be found in the *Gentleman's Magazine* for May 1841 (pp. 541–543).

he had been a successful teacher of those scientific doctrines which he afterwards opposed, both by serious argument and ridicule.*

Undoubtedly the prime mover of this curious change was the alteration which took place in his doctrinal views of religion. Having been led to conclude that he had been betrayed by authority into the belief of propositions both inexplicable and false, the tendency to think that the inexplicable must be false, or at least to regard the former with strong suspicion, was a necessary ingredient of his future reflections on all subjects. The manner in which several leading doctrines of physics and mathematics had been handled by names of celebrity, was highly calculated to call out this disposition. The doctrine of attraction,—a mysterious connexion between matter and matter, with no existence but in its results; the theory of quantities less than nothing, a phrase which, arithmetically considered, is a simple contradiction of terms, were adopted at the time when Mr. Frend taught, in a most positive and substantive sense, by the majority of investigators and all elementary writers.

It was in vain that Newton, obviously hoping for some further elucidation of his great regulator, concluded the *Principia* with a caution that he had *not yet* (*nondum*) found out the source of gravitation; his successors and commentators, with one voice, pronounced him the discoverer of the final mechanical cause of the planetary motions; and popular writers, who seldom refuse to say B when their leaders have said A, added that Newton had found out *why* water runs down hill. With respect to algebra, the matter was still worse. Euler asserted downright that a penniless man, fifty crowns in debt, has fifty crowns less than nothing; and offered proof. He assumes that a gift of fifty crowns would make this man richer; and supposing him to employ the gift in the payment of his debts, then concludes that he *had* less than nothing, because, being now richer than before, he *has* only nothing. Others admitted the negative and impossible quantities as mysteries, and, reversing Mr. Frend's process, brought them forward as auxiliaries to the mysteries of the orthodox forms of Christianity; a practice not extinct in our own day, even after all that was inexplicable about impossible quantities has disappeared. At the time when Mr. Frend first thought on the subject, the assertion of mystery was the escape from the confession of incompleteness; the great mass of readers followed with implicit confidence, while, of those who thought for themselves, an enormous majority was too sensible of the value of the results of algebra to abandon it on account of difficulties. Some few rejected the peculiar doctrines of algebra altogether; among whom those of most note were, in succession,

* In a magazine which lasted for a few months of 1803, *The Gentleman's Monthly Miscellany*, of which Mr. Frend was editor, or co-editor, is an article by him, entitled "Pantagruel's Decision of the Question about Nothing," in which the manner of Rabelais is so well caught, that any one on a first perusal would think it likely to be an actual adaptation or parody, until a search through the writings of Rabelais satisfied him that it was simple imitation. It is a satire against some parts of algebra.

Robert Simson, Baron Maseres, and Mr. Frend. Most of those who were independent of authority united in blaming the method of the elementary writings, and were content to hope that a palpable guide to truth would not always be without rational connexion with undeniable axioms. Woodhouse, the restorer of thought on first principles at Cambridge, in a letter to Baron Maseres, preserved among Mr. Frend's papers, and dated November 16, 1801, distinctly lays it down that, in these matters, it is not the principles which prove the conclusions, but the truth of the conclusions which proves that there must, somewhere or other, be principles. "Whether or not," says he, "I have found a logic, by the rules of which operations with imaginary quantities are conducted, is not now the question; but surely this is evident, that, since they lead to right conclusions, they *must have a logic*." And he goes on thus: "Till the doctrines of negative and imaginary quantities are better taught than they are at present taught in the University of Cambridge, I agree with you that they had better *not* be taught; and the plan of our system of mathematical education, much as it is praised, needs, in my opinion, considerable alteration and reform; and perhaps you think that our late mathematical publications will not much increase the love or improve the taste for luminous and strict deduction." As concerns the mystics, then, there is no need to object to Mr. Frend's entire abandonment of their principles, but the reverse; for it may be asserted that most of those who thought about first principles did the same. Those who imposed on matter, in the name of Newton, a primary power of attracting other matter, with those who could, on their own definitions, be made to say that *a command to subtract* 2, *repeated as many times as there are units in a command to subtract* 3, *gives a command to add* 6, ought to have been surprised that they found so little opposition.

But the circumstance relative to Mr. Frend's ultimate views which is peculiar to himself, and which cannot be remembered without surprise, is, that in clearing the trammels of mystery he had to force so thick an enclosure, that he left behind him not only the mysterious explanation, but the very facts which were professed to be explained, and which, it may be thought, could have admitted of no doubt. It seems to any one who reads his writings, that he means that Newton had done nothing out of mathematics, and that the *results* of algebra are all delusion. That the planets, attraction or no attraction, move about the sun, and are disturbed, precisely as it would be if there were attraction; that the truth of an equation, though produced by aid of impossible quantities, may be verified by numerical computation — may be made purely experimental realities, and would, to most minds as well acquainted with the subject as that of Mr. Frend, remain true, even though attraction were the atheism which some formerly called it, and the doctrine of negative quantities were a part of the black art. Nor would it have been wonderful if he had rejected incomplete explanations in elementary writing, the object of which is to teach clear results of clear principles. But there was more than this: sometimes, though rarely,

he seemed to have a power of admitting the facts as facts; but for the most part, when they were presented to him in conversation, his mind did not appear capable of dwelling on them long enough to decide whether an answer was required or not; they seemed to slip like water through a sieve. In this there was neither affectation nor evasion; it was a peculiar state of mind with regard to what could be contemplated as a scientific truth, and may be partly explained.

Mr. Frend had an admiration of simplicity, and an indisposition to arrive at complex results, which was perhaps a consequence of the desire to have no secret in philosophy. Next to the abandonment of all that was difficult to explain, followed the practical rejection of every thing in which the mind could not hold the full explanation at once before itself, in all its parts. The simple theory of numbers, that is, of integer numbers, was therefore naturally a favourite study; and this branch of mathematics is well known to be an extremely powerful stimulant of that disposition which leads to its pursuit. Legendre has said that it almost always becomes a species of passion with those who give themselves to it at all. With Mr. Frend it went still farther; an equation with a fractional root, even if commensurable, was a pseudo-equation; and $x^2 + y^2 = 1$, x and y being rational fractions, was an illegitimate child of $x^2 + y^2 = z^2$, x, y, and z being integers. In this particular Mr. Frend differed greatly from another remarkable person, his own most intimate friend, Baron Maseres, whose leading idea it seems to have been to calculate more decimal places than any one would want, and to reprint the works of all who had done the same thing.

There was also another peculiar circumstance which no doubt had considerable effect. Mr. Frend had studied Hebrew thoroughly, and was, in the opinion of learned Jews, better versed in that language than any English Christian of his day. No one who became acquainted with him could long avoid noticing the interest which he took in every matter directly or indirectly concerning the history and progress of Christianity. This knowledge of their language, history, and customs, with a community of opinion on the nature of the Deity, led him much into the acquaintance of his *elder brethren*, as he frequently termed them, of the Jewish race; and he would have held any biography of himself very imperfect which omitted to note how strongly he felt toward their persuasion. It seldom happens that any person devotes himself so keenly to any history without imbibing some opinion of the superiority of its subjects; and Mr. Frend carried to the very verge of paradox, or it may be a little beyond, the notion that the mathematical and astronomical science of ancient Judea was substantially equal at least to that of any period of modern Europe, not excepting the present. Their lunar calendar was as good as if it had been made from modern observations, and much better adapted to represent a long period than any other; as much of pure mathematics as any one ought to admit flourished among them in the time of Solomon. It is needless to say, that not a vestige of historical evidence was ever produced in favour of these opinions, nor did we ever hear of any

modern Jew who had carried his notions of the learning of his ancestors to such a length. Among modern nations, Mr. Frend had a peculiar respect for the Chinese, and was impressed with the opinion (not by any means peculiar to himself) that their government and social state is a model. The rudiments of science which he found among these nations, the ancient Hebrews and the modern Chinese, were easily magnified by his temperament, which was both sanguine and contemplative, into as much of astronomy and arithmetic as he had been able to save from the pollution of attraction and negative quantities; consequently, these countries were the depositories of real science, uncorrupted by sophistry. For the ancient Greeks and their writings he had an open contempt: they were children who had learned of the Jews, and spoiled their masters' doctrines: the good was due to their teachers, the bad was their own. All this time, and in the midst of such strange singularities of opinion as were never long absent from his mind, there was an eagerness to see the good of every thing actually present, which made his approbation very easy to gain. No one who talked with him could soon fathom the wide difference of sentiment between the two; for whatever might be the subject, there was a side on which it could be favourably viewed; and for that side Mr. Frend's mind, or that part of it which regulated his first expressions, had the quality (we must not say the attraction) of a magnet. His persuasion of the rapid advances which his contemporaries were making in morals, arts, and even sciences (however corrupted), was a spring of comfort to his age which never ran dry; and his interest in every thing new, which promised improvement to any class of mankind, in any one of those particulars, was, even after he was unable to speak or move, a commanding instinct, which he could not have disobeyed if he would. This unvarying effort to detect good in whatever came before him was essentially linked to his religious feelings, the source of his daily comfort, by the view which he never ceased to take of the ultimate consequences of Christianity; which he looked upon as the gradual restorer of mankind to a state of perfect goodness and knowledge. Every advance in art, learning, or science,—every amelioration of social evils,—every improvement in the law,—every evidence, however slight, of disposition to act, think, or hope, for the better, brought before him his cherished prospect of the final state of mankind, and was, in his opinion, only a step towards it. The consequence was, that any one who would wish to describe his age, must simply invert each and all of the characteristics which Horace* makes significative of the advanced periods of life.

* "Multa senem circumveniunt incommoda; vel quòd
Quærit, et inventis miser abstinet, ac timet uti,
Vel quòd res omnes timidè gelidèque ministrat
Dilator, spe longus, iners, avidusque futuri,
Difficilis, querulus, laudator temporis acti
Se puero, censor castigatorque minorum."

Mr. Frend's scientific writings were particularly distinguished by simplicity and earnestness. The greater part of the whole consists in short pamphlets, or communications to periodical publications; and many proofs might be given, both of the extreme importance he attached to truth, and of his conviction that error, even in matters of science, is a noxious weed in the field of morals. His principal distinct writings on subjects of science are his *Algebra* (Part i. 1796, Part ii. 1799), and his *Evening Amusements* (1804–1822). The latter was an astronomical elementary work of a new character, which had great success; and the earlier numbers went through several editions. It embraces a metonic cycle, and therefore describes the places of the moon, in a manner which would make it useful for a considerable time to come, in the elementary instruction for which it was intended. This present year is that which answers to 1804, so that the opportunity to repeat the process of instruction, so far as the moon is concerned, has just commenced. The phenomena of the different months are described, and to each month is usually attached a short religious reflection, an account of some astronomical process or discovery, a hit at the Newtonian philosophy, or some such preface. We do not see much acquaintance with the new doctrines of physics, which had then excited attention for some years; but it must be remembered that a man, who took his degree at Cambridge in 1780, had very little training in experimental deduction apart from mathematics.

Mr. Frend's scientific peculiarities strongly illustrate what those who have carefully considered the reading of that time will perhaps think to be the natural consequence of it, upon an exceedingly honest, clear, and decided mind, placed in circumstances favourable to the developement of opposition. The Cambridge student was isolated from experimental physics by the habits of his university, and from the progress of mathematics by its adherence to the fluxional notation. In essentials, the academic system was nearer to what it might have been at the death of Newton than those who now see its state could readily imagine to be possible: the theory of gravitation was taken wholly and solely from the *Principia;* no Englishman had made the smallest addition to it; and Clairaut, D'Alembert, &c. were only known by name as *French philosophers*, the most odious appellation of the time. One question might be asked which would, perhaps, add some force to the preceding remarks, if reasons for an answer were sought: — How came the men of science, who were bred at our English universities, to let Priestley, whose life was one turmoil of controversy, and who visibly must have written four pages a-day, or thereabouts, of theological discussion during his whole experimental career, run off with such a splendid portion of the first-fruits of real chemistry?

The other work of Mr. Frend, his *Elements of Algebra*, will lead every one who peruses it to think, with sincere regret, of his having preferred rejection to amendment; and will be a lesson to

writers yet to come, that they should let that stand which appears to lead to truth, whatever warning they may think it necessary to give that the reason why it does so lead is imperfectly understood. It is, on the points which it treats, the clearest book in our language. Something of this is due to the rejection of difficulty; something to the use of no problems except those which can be answered in integers; but there remains enough to shew that a work from such a writer, which should have taken algebra as it stood, distinguishing the part of which the logic was then complete from that of which the principles remained insufficiently understood, would have been the most valuable present which could have been made to the elementary student, and would, perhaps, have greatly accelerated the transition to the present state of the science, in which none need find a mystery. In all probability, the attack of Mr. Frend did materially influence this result. Among his papers is preserved a letter to him from M. Buée, a Frenchman residing in England, dated June 21, 1801, containing the form in which the perusal of Mr. Frend's work made the writer put together his own views of the subject; and admirably expressed. Of course it cannot be said how much suggestion was derived from the necessity of replying to specific objections: what is certain is, that in a few years from that time, this same M. Buée was, though in an imperfect manner, what Dr. Peacock calls the first formal maintainer of that exposition which removes the long standing difficulty.

Finally, whatever may be our opinion on the peculiarities of Mr. Frend's views, we must remember with high satisfaction that he was, during the last years of his life, one of our fellows; and, also, that no narrow idea of the necessity of conformity of opinion prevented a man of his intellectual station from being called to the Council of the Society. The sincere regret with which the Council announces the loss which our Body has sustained is materially lessened by the reflection that his extensive learning, practical wisdom in the affairs of life, chivalrous assertion of all that he thought true, and extraordinary benevolence of feeling, were permitted a long and useful career, terminated only by natural decay, and followed by the love of many, and the respect of all.

It is well known to many of the Members of this Society that an enlarged and improved Catalogue of the Stars, arranged after the manner of the Catalogue of this Society, has been a long time in progress, under the auspices of the British Association. That work is now nearly completed, and ready for the press, and will contain above 8000 stars. To each star will be annexed not only the annual precession, but also the secular variation of such precession, and the proper motion when it can be ascertained. The usual constants for determining the apparent positions of the stars at any required epoch, will also be given. This work

cannot fail of being a valuable addition to the resources of the astronomer.

The Members may be interested in learning that the Standard Scale of this Society has been reported to Her Majesty's Government, as one of the best means of regaining an accurate determination of the Standard Yard that was destroyed in the conflagration of the two Houses of Parliament: and that an indirect overture has been made for the acquisition of it, should the Government eventually consider it desirable. The Council apprehend that the Members would readily accede to any arrangement in this respect, which would promote the object that the Government has in view, and at the same time not be injurious to the interests of the Society.

The British Association having appointed a Committee to consider the propriety of revising and re-arranging the constellations in the heavens, Sir John Herschel has drawn up an interesting paper on this subject, which has been read before the Society, and printed in the forthcoming volume of the *Memoirs*. As it was considered desirable that an early and extensive circulation of his views on this subject should take place, the Council ordered an additional number of copies of this paper to be printed, which have been generally distributed, with a view of drawing the attention of astronomers to this branch of the science. Sir John's revision has been confined to the southern hemisphere, where the greatest confusion prevails in the nomenclature of the stars and in the distribution of the constellations: and if the reform, which is here suggested in the south, should meet the approbation of astronomers, it may become a matter of consideration, whether the principle may not be extended into the northern hemisphere, which has been sadly confused by modern innovations.

Since the last Anniversary, Her Majesty's Government has put the Society in possession of two rooms on the basement story of the present building; which have been cleaned out and appropriated for the erection of any apparatus that may be required for pendulum experiments, or for prosecuting any other investigations that may be carried on in such apartments.

It had long been a subject of regret that the immense magazine of facts contained in the Annals of the Royal Observatory from the time of Bradley's appointment, downwards, till a very recent epoch, should remain in a great degree unavailable for astronomical use. Our illustrious associate Bessel, in his *Fundamenta Astronomiæ*, corrections to the solar tables, and finally by his *Tabulæ Regiomontanæ*, rendered this vast labyrinth permeable, and extracted and exhibited in a finished shape much of its valuable contents. Some years ago, the British Association proposed to the Government the reduction of all the Greenwich *planetary* observations under the gratuitous superintendence and responsibility of the present Astronomer Royal, and at his own suggestion. That work is now completed, and it is understood that the funds required for printing the results will be furnished by the Board of Admiralty.

The planetary places are compared with the best existing tables, and the difference in heliocentric longitude and latitude given exactly as in the recent volumes of the *Greenwich Observations*, with a term which takes into account the errors of the solar tables, should any sensible errors be therein found. It need not be said to the members of this meeting that every care has been taken, by duplicate computations and frequent comparisons, to attain all practicable accuracy. The geometer who undertakes the revision of the theory of a planet will now have no labour which could be spared, and will be freed from every difficulty which is not inherent in the problem itself; so that we may feel tolerable confidence a few years will see us in possession of tables very far indeed advanced towards perfection.

But this work, laborious as it has been, yields in importance to that which has been subsequently undertaken by the Astronomer Royal (also gratuitously), the reduction of all the Greenwich observations of the moon, from Bradley downwards, together with a comparison of the observed places with those deduced from Plana's theory. Considerable progress has already been made. The R. A. and N. P. D. of the moon's bright limb, with the corresponding mean solar time, are computed; MSS. tables, consisting of an extension of Damoiseau's tables for 1824, modified by the introduction of Plana's co-efficients and new terms, are nearly ready. The skeleton forms are prepared, and some steps in the computations taken. The liberality of Her Majesty's Government has enabled the Astronomer Royal to employ fourteen calculators on the work, which is consequently advancing with all possible speed and economy. Let us hope that no pause will be made until a new set of lunar tables of home manufacture are produced, which shall define the place of our hitherto incorrigible satellite with the accuracy of the best observations, and sufficiently for the nicest purposes of geography. Your Council feel that you will heartily join with them in their respect for the talents, disinterested activity, and *official* piety of the Astronomer Royal, and in thanks to the Government for its discriminating and liberal patronage of our science.

The Council are glad to have it in their power to report to the meeting, that the difficulties which seemed to lie in the way of successful completion of the Cavendish experiment have been removed, by new precautions against the radiation of heat from the large balls. Though many experiments may, in the early investigations, have been apparently wasted, yet in reality much good must result from the new light thus thrown upon the details of the operation itself, and on the torsion-balance, which is the principal instrument employed. Considering the nature of the quantity required, the results begin to assume a degree of accordance with each other which promises a very accurate determination of that great element of the solar system, the mean density of the earth. The slight discrepancies which still remain, and which appear to shew that some-

thing depends on the substance employed, and more on unknown circumstances connected with the torsion-balance itself, are not such as to throw any reasonable doubt on the density obtained being true within less than a hundredth part of the whole. So much can safely be said at the present time; and it is not improbable that a still smaller limit of error may be substituted for the one just named. Mr. Baily's final report may be soon expected, and in the meantime some detail of the history of the experiment is actually in the hands of the Secretaries, and will shortly be read at an ordinary meeting of the Society. The work itself will form the fourteenth volume of the *Memoirs*, and a portion of the tables is already in the hands of the printer.

The Council have the satisfaction of announcing that the thirteenth volume of the *Memoirs* will be ready, perhaps, before the completion of the twelfth; Mr. Baily, having been lately engaged in reprinting, at his own expense, the catalogues of Ptolemy, Ulugh Beigh, Tycho Brahé, Halley, and Hevelius, in the type and form of our *Memoirs*, has offered the whole to the Council, to form the volume in question. As might have been expected, these catalogues have undergone such a revision and comparison as will materially increase their utility, and make these integrant portions of the history of astronomy familiar to the observer of our own day, who now looks upon them as difficulties, and refers to them (if, indeed, he have so much as the means of doing so at all) as little as he can help. The outlay saved to the Society by the manner in which this volume comes to us, though deserving and obtaining our warm acknowledgments, is the least part of the benefit; nor could the Council have omitted one word of the preceding testimony, if the manuscript, being, as it is, such as would gladly have been received, had been presented in the usual manner.

The whole of the volume is printed, excepting the preface, of which a circumstance well known to the Society at large has delayed the execution. And here, though it may be unusual to refer to the incidents of private life, yet the Council are sure that this meeting would feel disappointed if some opportunity were not given to the members of the Society to congratulate each other, and Mr. Baily, upon his most welcome and providential escape from the consequences of one of those accidents to which the inhabitants of crowded cities are daily exposed: an accident which, as all present remember, almost removed all hope of recovery, and made it seem next to impossible that life, if spared, should have been again occupied in the promotion of knowledge, and least of all in active research. Seeing him once more among us, in perfect health of mind and body, and remembering how much more probable it lately appeared that we should now be commemorating his innumerable services to the Society than anticipating their continuance, the Council drop the subject with the expression of their earnest hope that a life preserved against all expectation may be preserved beyond all expectation, and that a distinguished career may yet

await one of the earliest and the most indefatigable friends of the Society.

In the Address of the President at the last Anniversary of the Society, honourable mention was made of Mr. Henderson's investigations relative to the presumed parallax of α *Centauri*. These investigations have been continued to the present time; and from some observations recently received by him from Mr. Maclear, at the Cape of Good Hope, he is confirmed in his opinion relative to this subject, and considers the parallax to be about 1″. The Council trust that they shall soon receive from Mr. Henderson a detailed memoir on this important subject, which will then be read at the ordinary meeting of the Society.

The Council regret that they have to announce the retirement of Lieut. Raper from the office of Secretary to this Society; an office which he has filled with the greatest zeal and attention, and which calls from this meeting the expression of their best thanks. Nothing but the love of science and the talents which he possesses could have induced him to take so active and important a duty, oftentimes at a sacrifice of private ease and convenience: but this remembrance is at once the source of our approbation and the cause of our regret.

The Council trust that the award of the medal to Professor Hansen will meet the approbation of the Society. The labours of M. Hansen are well known to those astronomers and mathematicians who have attended to, and cultivated, that branch of inquiry which more especially relates to those abstruse and intricate points of investigation that require the greatest exercise of mental exertion. The grounds on which this award has been made will be more fully explained in the Address of the President at the close of this Report.

Titles of Papers read before the Society, between February 1841 *and February* 1842.

1841.

Mar. 12. On a Reformation of the Constellations, and a Revision of the Nomenclature of the Stars. By Dr. Olbers. Translated and communicated by Sir J. F. W. Herschel, Bart.

Continuation of the Investigation for the Correction of the Elements of the Orbit of *Venus*. By J. Glaisher, Esq.

April 7. Occultations of Stars by the Moon, observed at Ashurst and Dulwich, in the year 1840. By R. Snow, Esq.

Observations on the Variability of the Star α *Cassiopeiæ*, during the years 1839 and 1840. By R. Snow, Esq.

Description of the Observatory erected at Starfield, Liverpool. By W. Lassell, Esq. Jun.

Observations on Bremicker's Comet, with its Apparent Places, as obtained, with the Equatoreal, at Mr.

1841.

Bishop's Observatory; and an Account of the Methods employed in deducing them. By the Rev. W. R. Dawes.

May 14. Description of a Dioptric Telescope, and a Micrometrical Lunette. By M. Chevalier. Translated by R. W. Rothman, Esq.

Observations on the Aurora Borealis. By R. Snow, Esq.

Mean Positions of the Stars mentioned in Mr. Baily's Address to Observers, determined at San Fernando in the years 1834 to 1838. By M. Montojo. Translated by Capt. Shirreff, R.N.

June 11. A New Catalogue of Moon-Culminating Stars, observed at South Kilworth. By the Rev. Dr. Pearson.

On the Advantages to be attained by a Revision and Re-arrangement of the Constellations, with especial reference to those of the Southern Hemisphere, and on the Principles upon which such Re-arrangement ought to be constructed. By Sir J. F. W. Herschel, Bart.

Nov. 12. On the Longitude of Dr. Lee's Observatory at Hartwell. By the Rev. George Fisher.

Observations of the Beginning and Termination of the Solar Eclipse of July, 1841, at Aberdeen. By Charles Crombie, Esq. Communicated by George Innes, Esq.

Observations of the Lunar Occultation of *Venus* on September 11, 1841, at Mr. Bishop's Observatory, in the Regent's Park. By the Rev. W. R. Dawes.

Notice of the Occultation of *Venus* on the 11th of September, 1841. Observed at Malta, by Capt. Basil Hall, R.N. Communicated by Capt. Beaufort, R.N.

Observations of Bremicker's Comet made with the Equatoreal Instrument of the Observatory of Padua. By M. Santini.

Introduction to a Catalogue of 1677 Stars included between the Equator and 10° of North Declination, observed at the Observatory of Padua. By M. Santini. Communicated by Sir J. F. W. Herschel, Bart.

Dec. 10. Observations of the Solar Eclipse of July 18, 1841. By the Rev. Professor Chevallier.

A new Method for greatly facilitating the Computation of the Moon's Co-ordinates. By S. M. Drach, Esq.

Thoughts on Shooting Stars and Comets, suggested by the perusal of Mr. Galloway's paper on the subject, read before the Society on January 8, 1841. By

1842. S. M. Drach, Esq.

Jan. 14. Observations of Halley's Comet, made at the Observatory of Geneva, in the years 1835 and 1836. By M. Müller, under the direction of M. Gautier, Director of the Observatory. Communicated by Sir J. F. W. Herschel, Bart.

1842.

Jan. 14. Note on the Masses of *Venus* and *Mercury*. By R. W. Rothman, Esq.

Observation of the Immersion of p^2 *Leonis* behind the Dark Limb of the Moon. By R. Snow, Esq.

Extract of a Letter from Professor Encke to Mr. Airy, dated 20th December, 1841. Translated from the German. Communicated by G. B. Airy, Esq.

Comparisons of the Planet *Venus* in Æ. and N. P. D. with the Star A. S. C. 423, made with the Equatoreal Instrument of the Observatory at Ashurst, on April 9, 1841. By R. Snow, Esq.

Reduction of Mr. Snow's Observations of *Venus* and the Star A. S. C. 423, with some Remarks upon the Employment of Equatoreals in Planetary Observations. By the Rev. Richard Sheepshanks.

List of Public Institutions and of Persons who have contributed to the Society's Library, &c. since the last Anniversary.

American Philosophical Society.
Society of Arts.
Royal Asiatic Society.
The Lords Commissioners of the Admiralty.
Royal Academy of Berlin.
British Association.
Royal Academy of Sciences, Brussels.
Cambridge Philosophical Society.
Editor of the Athenæum Journal.
Royal Society of Edinburgh.
L'Académie Royale des Sciences de l'Institut de France.
Royal Geographical Society.
Geological Society of London.
Royal Irish Academy.
Imperial Academy of Sciences at St. Petersburg.
Historical Society of Sciences.
Her Majesty's Government.
Meteorological Society.
Linnean Society of London.
The Editor of the Microscopic Journal.
L'Administration des Mines de Russie.
Royal Observatory of Brussels.
The Observatory at Milan.
The Observatory at Vienna.
The Observatory at Vilna.
Royal Society of London.

Professor Bessel.
Miss F. B. Burton.
F. G. Bunt, Esq.
Rev. J. Challis.
M. Dien.
Professor Encke.

G. Fischer, Esq.
M. Francoeur.
T. Forster, Esq.
W. Galbraith, Esq.
J. O. Halliwell, Esq.
J. Herrapath, Esq.
E. O. Kendall, Esq.
Dr. Lamont.
A. Parsey, Esq.
Rev. B. Powell.
Professor Quetelet.
Rev. R. Sheepshanks.
Professor Schumacher.
M. Simonoff.
Capt. W. H. Smyth.
Lieut. W. S. Stratford.
R. Taylor, Esq.
M. Wartman.

The President (the Right Honourable Lord Wrottesley) then addressed the Meeting on the subject of the award of the Medal, as follows:—

Gentlemen,—Since the great discovery of the law of gravitation, the means by which the astronomy of the solar system has been advanced to its present state of perfection are of two distinct kinds. The first consists in the collection of facts from observation,—or, it may be said, in the application of that complicated and refined system of operations whereby the practical astronomer is enabled not only to assign the exact positions which the several bodies belonging to the system occupy at the moment of observation, but also to determine the paths they describe in space, and the laws by which their motions are governed. The second is that which is employed by the geometer. Setting out from the law of gravitation as established by Newton, and borrowing only from observation the elements which are necessary for the institution of his calculus, his object is to deduce from theory alone the whole of the phenomena of the system, even to their minutest details, and, by a comparison of his results with observation, to determine the masses of the different bodies, the influences which they exercise on the motions of each other, and the amount by which the elements of their fluctuating orbits deviate from their average conditions;—to express in formulæ the state of the system and the position in space of every body belonging to it at any given instant in past or future duration; and, finally, to convert his formulæ into numerical tables, for the uses of navigation and the other important purposes to which astronomy is subservient.

It is for researches in this second department of our science, undoubtedly the most arduous and difficult of the two, that your Council have awarded the Society's Gold Medal for the present year to Professor Hansen, the Director of the Observatory at Seeberg, and, according to annual custom, the duty devolves on me of stating to you the grounds of their decision. The subject is not very susceptible of popular explanation: in fact, the especial services which Mr. Hansen has rendered to astronomy consist in the developement of new formulæ, and the exhibition of new artifices of calculation, in the remotest and most abstruse departments of mathematical analysis. Nevertheless, I trust I shall be able to convey such an idea of their nature and object as will enable you at least

to appreciate the motives which have influenced your Council in conferring on our illustrious Associate this testimony of the Society's approbation.

In proceeding to determine the motions of a celestial body urged by a central force, and disturbed by the action of other bodies, the accelerating forces in the direction of rectangular co-ordinates are expressed by three differential equations of the second order, which, as is well known, can only be integrated by approximation. To obtain approximate integrals, two methods have been principally followed. The first consists in deducing from the differential equations, expressions for the variations of the radius vector, longitude, and latitude of the disturbed body in a function of the disturbing force and its partial differentials; and in integrating these expressions, either by developing them in series which proceed according to the powers of the eccentricities and inclinations, or else by the method of parabolic quadratures. This is the most obvious method of determining the perturbations, and also the simplest when the approximations are only carried to terms of the order of the eccentricities and inclinations; but when a closer approximation becomes necessary, and terms of a higher order are required to be included, the expressions become complicated, and the method accordingly loses its advantages.

The other method of obtaining approximate results is known in analysis as the method of *variation of arbitrary constants.* This method, though undoubtedly entitled to be regarded as one of the most ingenious artifices of modern analysis, is suggested in a manner by the peculiar constitution of our solar system, in which the disturbing forces which act upon any body bear so small a proportion to the principal force which determines the general orbit, that the body may be regarded as moving always in an *ellipse*, but in an ellipse whose elements are in a state of continual though extremely slow change. In accordance with this idea, the origin of which may be referred to Newton himself, the accelerating forces which act on a celestial body are conceived to be divided into two parts, one of which renders integrable the differential equations between the co-ordinates and the time, and gives the elliptic orbit which the body would describe about a centre of force if there was no disturbance; while the arbitrary quantities introduced by this first integration are supposed to be rendered variable by the other part, and their variations determined by means of differential equations of the first order, whose integrals (usually obtained by successive approximation) give the elements of the true perturbed orbit, from which the radius vector, longitude, and latitude of the body at any given time are computed.

The first example of this method of computing the planetary perturbations was given by Euler in the *Berlin Memoirs* for 1749, where he obtains the differential equations of the first order of the inclination and longitude of the node by varying the arbitrary constants which express these two elements in the elliptic orbit. But

though Euler afterwards succeeded in finding expressions for the variations of some of the other elements, the complete developement of the method, and its application not only to physical astronomy, but to the general theory of mechanics is due to Lagrange; and it forms the distinguishing feature, so far as dynamics are concerned, of the beautiful system of mathematical analysis which that illustrious geometer has bequeathed to science in the Mécanique Analytique.

The method of analysis which we are now considering, is attended with peculiar advantages when applied to the determination of the *secular* inequalities of the orbits, in the developement of which the greatest triumphs have been achieved of which physical astronomy can boast since the discoveries of Newton. It was by this means that Lagrange demonstrated that the greater axes of the planetary orbits are affected by no inequalities independent of the configuration of the bodies, and consequently that amidst all the fluctuations of the system, the mean distances of the planets from the sun, and therefore also their mean motions, remain for ever and unchangeably the same. It was by the same means Laplace formed exact expressions for the secular variations of the eccentricities and inclinations, and thence proved that the changes of those elements must always be inconsiderable; that they do not increase indefinitely with the time, but after a longer or shorter period again resume their former values. These conclusions, which were confirmed by the subsequent and more complete analysis of Poisson, lead immediately to what may be regarded as the most remarkable triumph of modern science, namely, the stability of the solar system; for they shew that, however the motions and positions of the several planets and satellites may be deranged and disturbed by their mutual perturbations, the variations which take place in the magnitudes and forms and positions in space of the different orbits are not only periodic, but confined within narrow limits.

But, although in the hands of these great masters of analysis the method of varying the elliptic elements led to the sublime discoveries now alluded to, it is not without defects, which become particularly sensible in the numerical computations. Among these is to be reckoned the length of the calculations which it renders necessary for two reasons; first, because the number of elements of an orbit being twice the number of the co-ordinates which determine the place of the body, the calculation of a much greater number of quantities is required than by the first-mentioned method; and, secondly, because when the perturbations of the elements have been computed, there still remains the labour of substituting the altered elements in the expressions of the co-ordinates derived from the elliptic motion, in order to obtain the disturbed co-ordinates and the place of the body in its actual orbit. The principal defect of the method, however, consists in this, that the coefficients of the different terms of the series which express the disturbed elliptic elements have, in general, much larger values than the corre-

sponding terms of the expressions of the disturbed co-ordinates which determine the position of the body, so that the series expressing the disturbed elements converge slowly, even when they correspond to small perturbations of co-ordinates. If we conceive, for example, a system of forces of short period to disturb the curvature of an orbit many times in a single revolution, it will be easy to see that in each of these periods the elements of the orbit may have been greatly altered, while the disturbance of co-ordinates (of the longitude and radius vector, for example) may have been trifling. But in order to obtain these small disturbances, it is necessary to pass through the perturbations of the elements, which, relatively, are very considerable, and of which the calculation is rendered laborious by reason of the slow convergence of the series; and this inconvenience exists not merely in the case of the perturbations of the first order with respect to the masses, but in a still greater degree in the case of those of the second and of the higher orders. For these reasons the calculation of the perturbations has hitherto been in some respects imperfect and unsatisfactory; the computer always finding himself obliged to omit a number of the smaller terms without having any assurance that the error resulting from the omission is insensible; or, as Mr. Hansen has remarked, rather from a sort of presentiment that the omitted terms have no appreciable influence, than from a mathematical demonstration of their influence being insensible.

It was with a view to remove these defects from the lunar and planetary theories that Mr. Hansen undertook the series of remarkable investigations which have appeared from time to time, during a considerable number of years (partly in Professor Schumacher's invaluable Repertory, the *Astronomische Nachrichten*, and partly in two separate publications,— one on the perturbations of *Jupiter* and *Saturn*, and the other on the lunar theory), for which the Council has now awarded the Society's medal. His method of expressing the perturbations is based on that of Lagrange; but the modifications which he has introduced are of an important kind, and lead, in fact, to an entirely new mode of conducting the numerical calculations; so that, if it cannot be said that he has furnished us with a new instrument wherewith to attack the difficulties of the problem, he is at least entitled to the merit of having taught us a new method of applying that of which we were already in possession.

On taking a general view of Hansen's method, the point which first presents itself as remarkable, and that indeed in which the novelty of his process essentially consists, is the original and highly ingenious artifice which he employs in order to arrive at the expressions for the perturbed co-ordinates,— namely, the longitude, radius vector, and latitude. In the usual method of proceeding, the arbitrary constants introduced by integration are determinate functions of the elliptic elements and time, and the perturbations of co-ordinates are obtained by supposing the elements to vary. Instead of the true time, Mr. Hansen introduces into the functions

an analogous, but indeterminate, quantity, and considers the elements as invariable. He then determines the variations which this quantity must undergo (in other words, he finds what alteration must be made in the *time*, in the place where it enters explicitly into the elliptic formulæ), in order that the elliptic formulæ, with altered time and invariable elements, may give the same value of the indeterminate functions as would be found by using the true time and variable elements. Suppose, for example, the function of elements and time to be the true longitude; then the problem, according to Mr. Hansen's method of viewing it, amounts to this:— To find the perturbations which must be applied to the mean longitude, in order that the true longitude deduced from it with the use of invariable elements, may be the true perturbed longitude.

It is evident that the use of invariable elements, and time altered so as to give the correct value for longitude, would not, with the elliptic formulæ, give a correct value of the radius vector; but this difficulty is surmounted in an extremely ingenious manner by the introduction of subsidiary terms which, being applied as corrections to the radius vector of the unaltered elliptic orbit (*i. e.* unaltered except in time), give its true perturbed value. By similar considerations an expression is found for the latitude in the disturbed orbit. It would be impossible, however, without the aid of algebraic symbols, to give an idea of the analytical processes employed for determining these subsidiary terms; and for the same reason I must content myself with a bare allusion to the still more remarkable artifice to which he has recourse in order to obtain an expression for the continuous variation of the perigee and node of the lunar orbit, for which, by reason of their rapid revolution, invariable elements will clearly not suffice, and a departure in some degree from the original principles becomes necessary.

These deviations from the usual methods lead to very important advantages in the calculation of the tables, for the series expressing the perturbations of co-ordinates are not only rendered more convergent, whereby a smaller number of terms is required to be computed, but the coefficients of the individual terms are obtained with a smaller amount of labour than was necessary in the methods hitherto employed.

It will be readily seen from what has now been said, that the general aim of Mr. Hansen's researches is the improvement of the methods of expressing the lunar and planetary perturbations, so as to render the numerical calculations more easy and more certain. There is, however, one advantage which Mr. Hansen states to belong to his method, of by far too important a kind to be passed over without particular notice. It is this: — In the series which express the values of the disturbed co-ordinates, every term exceeding a certain numerical value, assumed at pleasure, can be immediately recognised, so that all those terms which fall below the assumed value may be rejected from the first, with the certainty that their sum falls within a given limit. The certainty thus

acquired that every term having a sensible value is retained in the calculation, is an improvement in the theory on which it would be difficult to set too high a value; and in fact it removes the principal defect which has hitherto attended all the methods of approximation which have been proposed. Nor is this advantage obtained by any sacrifice of generality; for neither with respect to the eccentricity and inclination, nor powers of the mass, is any other restriction introduced than is inseparable from the nature of the problem.

Besides these principal advantages of more rapidly converging series, and certainty with respect to the value of the omitted terms, there are some minor advantages incidental to the new method, which, however, are still of great importance. Among these may be mentioned certain relations subsisting among the analytical expressions of the co-ordinates, pointed out by Mr. Hansen, from which equations of condition are deduced which not only facilitate the calculations but afford a ready means of verification.

The applications which Mr. Hansen has as yet made of his method are to the Inequalities of *Jupiter* and *Saturn*,* in a Memoir which obtained the prize of the Royal Academy of Sciences of Berlin; and, to the lunar theory, in a work recently published.† In the former Memoir the theory is worked out to a numerical result. The expressions for the differential values of the longitude, latitude, and radius vector, are integrated by the method of quadratures, and results obtained which agree with those derived from the ordinary methods of approximation founded on the smallness of the eccentricities and inclinations. The approximations are, indeed, only carried to terms of the second order inclusive, with respect to the masses; but, in the case of *Saturn*, all the terms of this order exceeding a certain numerical value are calculated. His theory of the lunar perturbations, which presents difficulties of a peculiar kind, is not so far advanced, and much is still wanting to render it complete even as a symbolical theory. But in a recent number of the *Nachrichten*‡ he has announced that the calculations, on which he has been for some time engaged, are now proceeding towards a conclusion; and he has given some results which shew that the new methods apply with as much advantage to the moon as to the planets.

Thus, gentlemen, I have endeavoured to place before you a sketch of Mr. Hansen's researches, which, brief and imperfect as it is, will enable you to understand their object, and appreciate their importance. Should it be thought that these investigations refer only to matters of detail, and that the results at which he has arrived include none of those grand discoveries which enlarge the boundaries of science, and give us, as it were, a new insight into the

* Untersuchung über die gegenseitigen Störungen des Jupiters und Saturns. Berlin, 1831.

† Fundamenta nova Investigationis Orbitæ veræ quam Luna perlustrat. Gothæ, 1838.

‡ No. 403.

constitution of the universe, let it be remembered that the progress already made in physical astronomy has narrowed the field to the present inquirer, and that, in proportion as science advances, its processes become more and more intricate. The problem of the universe, difficult as it is, is still a limited problem; and the successive steps in its solution may be assimilated to the terms of one of those converging series expressing the perturbations we have been speaking of, in which each succeeding term is not only smaller in value than the preceding, but also more difficult of calculation. It is with the smaller terms only that the theoretical astronomer has now to concern himself; but his labours, though necessarily attended with less brilliant results, are not on that account the less necessary or useful. On the contrary, no more valuable service remains to be rendered to Astronomy, in the present state of the science, than the improvement of the existing methods of computing the lunar and planetary perturbations. The labours of Mr. Hansen have been steadily, and perseveringly, and successfully directed to this end. Whether the new methods which he has so ingeniously developed will be found in all cases preferable to those with which we are already familiar, or whether they will ultimately be adopted by astronomers as affording the most convenient forms under which the conditions of the solar system can be expressed, is a question which your Council do not venture to decide, and on which, perhaps, it would at present be premature to form an opinion. But, with respect to the profound ingenuity and consummate analytical skill which he has brought to bear on the intricate subjects of his investigation, there can be but one voice. His researches, which have been of the most laborious and abstruse kind, have been directed to the highest and most important questions of astronomy; and the means by which he has sought to conquer the still remaining difficulties, present more of novelty and originality, and afford stronger hopes of removing the differences which still exist between the Tables and Observation, than any which have been employed since the variation of arbitrary constants was propounded by Lagrange. On the whole, having respect to the importance of the subject, the results which have already been obtained, and the promise afforded of future improvements, the Council doubt not that the Society, and astronomers in general, will ratify its decision.

The President then, addressing the Foreign Secretary, continued as follows:—

Mr. Rothman,—In transmitting this medal to Professor Hansen, assure him of the lively interest which this Society takes in the continuance of his important labours; and convey to him our warmest wishes for his health and happiness, that he may be enabled to complete those improvements in the most arduous departments of our science which he has so auspiciously commenced, and thereby acquire a still stronger title to the gratitude of astro-

nomers, and to a place among those who have most signally contributed to the developement of the theory of Newton.

The Meeting then proceeded to the Election of the Council for the ensuing Year, when the following Fellows were elected, viz.

President: the Right Hon. Lord Wrottesley, M.A. F.R.S.—*Vice-Presidents:* Francis Baily, Esq., F.R.S.; Rev. George Fisher, M.A. F.R.S.; Sir John F. W. Herschel, Bart. K.H. M.A. F.R.S.; Rev. Richard Sheepshanks, M.A. F.R.S.—*Treasurer:* George Bishop, Esq.—*Secretaries:* Rev. Robert Main, M.A.; Richard W. Rothman, Esq., M.A.—*Foreign Secretary:* Thomas Galloway, Esq., M.A. F.R.S.—*Council:* George Biddell Airy, Esq., M.A. F.R.S., *Astronomer Royal;* Rev. W. Rutter Dawes; Augustus De Morgan, Esq.; Thomas Jones, Esq., F.R.S.; John Lee, Esq., L.L.D. F.R.S.; Major-General C. W. Pasley, R.E. F.R.S.; Lieut. Henry Raper, R.N.; Edward Riddle, Esq.; Lieut. William S. Stratford, R.N. F.R.S.; Charles B. Vignoles, Esq.

SPECIAL MEETING.

A Special Meeting was holden after the business of the Annual Meeting was concluded, agreeably to the Bye-laws (Sect. iv. § 9), to consider the following Resolution, which was proposed on the part of the Council, the President in the chair:—

That Thomas Stevens Davies, Esq., Andrew Ure, Esq. M.D., and William West, Esq., being resident in England and having treated with neglect the repeated applications made by the Council, agreeably to the 5th Section of the Bye-laws, for payment of the arrears due by them, and having suffered their names to be suspended in the Meeting Room as defaulters since June 11, 1841, be expelled from the Society.

It having been ascertained at the commencement that more than twenty-four Fellows were present, a ballot was taken upon each name mentioned in the resolution; at the close of which the President announced that the three Fellows in question were severally expelled from the Society.

Errata in the Monthly Notice for January 1842.

Page 130, line 15, insert *the Earth* after *Venus.*

— 132, line 18, *for* $(1,0)\ \frac{e_0}{e}\cos(\varpi_0-\varpi_1)$, *read* $[1,0]\ \frac{e_0}{e_1}\cos(\varpi_0-\varpi_1)$.

— 132, line 19, *for* $(1,2)\ \frac{e_2}{e_1}\cos(\varpi_2-\varpi_1)$, *read* $[1,2]\ \frac{e_2}{e_1}\cos(\varpi_2-\varpi_1)$.

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